DOCUMENT RESUME

ED 395 109 CE 070 923

TITLE	Giving Voice to Student Writing: Exploring the Uses of Speech Recognition and Speech Synthesis in a Writing Curriculum. Final Report.
INSTITUTION	Drexel Univ., Philadelphia, PA. Office of Computing Services.
SPONS AGENCY	Pennsylvania State Dept. of Education, Harrisburg. Bureau of Adult Basic and Literacy Education.
PUB DATE	95
CONTRACT	98-5015
NOTE	28p.; For a related teacher and student manual, see CE 070 924.
PUB TYPE	Reports - Research/Technical (143)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Adult Basic Education; *Adult Literacy; Agency Cooperation; Computer Software; *Computer Uses in Education; Demonstration Programs; Editing; *Literacy Education; *Speech Synthesizers; Teaching Methods; *Writing Instruction
IDENTIFIERS	353 Project; Pennsylvania (Philadelphia)

ABSTRACT

A demonstration project explored the use of speech synthesis and speech recognition in writing-based classes held by two Philadelphia literacy providers. The project examined the use of high quality speech synthesis (the computer reads words from the screen in an understandable voice) and speech recognition (the computer responds to verbal commands) in facilitating press writing. The project used hardware and software that allowed learners to hear and edit their own writings on the computer. The software and hardware were integrated into writing-oriented classes already in place at the Community Learning Center and the Community Women's Education Project. Teachers at each location were instructed in the use of the hardware and software. Students wrote stories and listened to the computer read them back. Teachers reported that speech synthesis was useful for some students in encouraging more editing and better writing. Many students were able to recognize and correct more grammar and spelling errors after hearing their stories read back by the computer. The teachers thought that the program was worthwhile, especially for some students. Despite the claims of the creators of the speech recognition program, however, it took more computing power and time and energy to use than was provided for by the project. The project concluded that, although the technology offers promise in the future, it was not feasible to use it with the currently available version of the software. An additional result of the project was increased collaboration between the two agencies. (A protocol for process writing and a computer use log are included in an appendix to the report.) (KC)

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DREXEL UNIVERSITY

Office of Computing Services
Drexel University
Philadelphia, PA 19104-2884

FINAL REPORT

PROGRAM YEAR 1994-1995

SECTION 353 GRANT

98-5015

GIVING VOICE TO STUDENT WRITING:

EXPLORING THE USES OF SPEECH RECOGNITION AND SPEECH SYNTHESIS IN A WRITING CURRICULUM

DREXEL UNIVERSITY LITERACY PROJECT

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GIVING VOICE TO STUDENT WRITING

FINAL REPORT

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GIVING VOICE TO STUDENT WRITING

ABSTRACT

Giving Voice to Student Writing was a special demonstration project designed to explore the use of speech synthesis and speech recognition in writing-based classes held by two Philadelphia literacy providers.

This project sought to examine the use of high quality **speech synthesis** (the computer reads words from the screen, in an understandable voice) and **speech recognition** (the computer responds to verbal commands) in facilitating process writing. It utilized hardware and software that allowed learners to hear and edit their own writings on the computer. The software and hardware were integrated into writing-oriented classes already in place at the Community Learning Center and the Community Women's Education Project.

Teachers at each agency were instructed in the use of the hardware and software. Students wrote stories and listened to the computer read them back. Teachers collected and reported information on the effect of the computer reading to the students.

Speech synthesis proved to be useful for some students in encouraging more editing and better writing. Many were able to recognize and correct more grammar and spelling errors after hearing their stories read back by the computer. Most enjoyed and valued having access to this capability. The teachers unanimously felt that it was worthwhile, especially for certain students. When obtaining new equipment intended to be used in writing curricula, speech synthesizing software and hardware should be considered.

Despite the claims of the creators of the speech recognition program, it proved to take more computing power and time and energy to use than was provided for by this project. While this technology offers promise in the next few years to have a profound effect on how we understand reading and writing, it was not feasible to explore it with the currently available version of the software.

A secondary intention of Drexel's collaboration with these two agencies in the same building was to promote an internal computer support system between them and help build a critical mass of skilled users. This did occur, and they are continuing to use the computers and learn with each other.

GENERAL INFORMATION

EDUCATIONAL CONSIDERATIONS

This project was designed to permit Drexel University's Office of Computing Services to place computers with speech recognition and synthesis software in two Philadelphia ABLE agencies, the Community Learning Center and the Community Women's Education Project. It supported the training of teachers at each site in how to use and integrate the software with their process writing programs. It assessed the value of using this technology this way for this population. Finally, this project will support creation of a manual to enable other agencies to decide whether and how to implement similar projects.

An emerging educational area of inquiry that has had an impact on understanding the individuality of the learning process is the concept of learning styles. (Gardner, Howard, "Beyond the IQ: Education and Human Development," Harvard Educational Review, May 1987). Though there are many ways to examine learning styles, one of the most basic analyses indicates that some people learn best through seeing, others by hearing, others by doing. Everyone learns through all of these senses, but each person has unique learning, retention, and communication styles that emphasize the primacy of one of them.

Schools tend to provide an educational experience that may be highly effective for some learners but not so good for others. One reason is that schools may train to a specific combination of learning styles. They may emphasize learning by seeing at the expense of learning by doing or hearing. This may be one reason some learners succeed in school, specifically in learning to read, and others do not do as well.

Technology may be able to help. Computers can now carry out speech *synthesis* by using inexpensive software that examines text, running it through a set of pronunciation guidelines, then follows those rules to generate sounds that approximate the typed word or words. Speech recognition involves a user speaking into a microphone attached to her computer which then interprets these words, translating them into a computer action, such as typing text or printing a page.

Speech and audio technololgies promise to add a dimension of experience to the reading and writing process that may enjoyable and beneficial to learning. We believe it is worthwhile to explore new technologies that may benefit adult

learners. The purpose of this grant was to use computers and software to add audio components to writing, reading, and editing, and to explore whether and how speech synthesis and speech recognition could be useful for adult learners.

TECHNICAL BACKGROUND

SPEECH SYNTHESIS

All Apple Macintosh computers and some PC computers have had the capability of speech synthesis for a number of years. The quality of speech generation is controlled by the quality of the hardware and software, and the amount of memory the computer dedicates the task. In previous generations of computers, that were slower and could handle fewer sets of rules, the voices sounded robot-like and pronunciation was riddled with inconsistencies. But with the current technology the tone and inflections of the voices are quite lifelike. The clarity and human sound of the computer voice is also improved by higher quality speakers built into the AudioVision monitors used in this project.

Three speech synthesizing word processing programs were placed on the computers put into CLC and CWEP: SimpleText, a program from Apple that comes pre-installed on all current Macintosh computers; the Institute for the Study of Adult Literacy's Adult Literacy Word Processor; and Nisus, a high-quality commercial software product. Each program is different and offers advantages either in ease of use or in enhanced features, and Drexel wanted the teachers to be able to choose the program that would be best for them. In all of them, after typing text into the computer, the user selects the text they wish to hear spoken and chooses a "Speak" command. It is an easy to learn two-stage process and most of the students seemed to learn it after some opportunity to learn how to use the mouse. The computer then generates sounds that approximate a human voice pronouncing words, sometimes well, sometimes poorly. Users can listen to selected text or an entire document.

All the speech synthesis software used in this project are based in an Apple technology called PlainTalk. This technology which Apple distributes freely permits the computer to pronounce text in a variety of voices. Some of these were simple, pleasant male or female voices. Others were funny (sounding like bubbles were welling behind the voice) or interesting in other ways (three harmonized voices, sobbing voices, childlike voices). It is also possible with these prögrams to customize

the pitch, speed, and volume of each voice. So learners have the ability to individualize the voices and hear their work read the way that sounds best to them.

The process writing approach used by both agencies encourages peer review and collaboration, as well as publication and sharing of work. This project aimed to examine how the ability to hear text affects these aspects of writing.

SPEECH RECOGNITION

Speech recognition of any sort has been difficult to come by using previously available technologies. It has been prohibitively expensive. The hardware to use them has not been reliable. Such programs needed to be "trained" for many hours -- the user speaks into a microphone plugged into the computer and builds up a bank of words that appear on the screen. In order to recognize an individual voice these programs needed many hours of training. Frequently they were designed not to take continuous speech but to carry out menu commands such as "Save" or "Cut."

Yet speech recognition might have much to offer educators, especially those using writing in their programs. One of the tenets of process writing is that people learn to write best when they write a lot: "... the more they write, the more they practice creating written symbols from thought, eventually decreasing the necessity to translate through actual speech sounds." A drawback to using computers in the classroom is the necessity for users to have some facility with typing to write fluently. High quality, easy to use speech recognition might obviate this need.

Another tenet is that people learn best when they learn to experience writing as similar to speaking, rather than just "assignments." Content and voice are primary, with understanding of the mechanics of writing -- spelling, grammar, punctuation -- stemming from assignments based on the learners' own compositions. Again, speech recognition, by taking care of mechanical details, might facilitate the transfer of spoken words into printed text, focusing on ideas, content and voice.

In 1993 a product named PowerSecretary appeared. Priced at $2,500 it was supposed to run on any Macintosh with 12 Megabytes of RAM. This study was intended to examine how such a program could affect the learners in these two adult education programs.

GOALS AND OBJECTIVES

The objectives of this project were:

1. To place a computer, capable of speech synthesis and speech recognition, and appropriate software into two ABLE agencies, the Community Learning Center and the Community Women's Education Project;

2. To train one or more staff from each agency in the use of the computers and software and help them to integrate them into their writing curricula;

3. To offer guidance and assistance in using and evaluating the software through the course of the project;

4. To collaborate with staff in evaluating the value of using the technology;

5. To develop a manual outlining the use of this technology with ABE learners.

All five of these objectives were successfully met for the speech synthesis software. Technical difficulties prevented meeting curricular goals for the speech recognition software, though it was evaluated.

PERSONNEL

Dr. Janice Biros, Co-Manager, Office of Computing Services, Drexel University, administered this project and obtained software and hardware needed for its implementation. The trainer and project coordinator was Mr. Benjamin D. Burenstein. He trained agency staff, conducted ongoing support and evaluation of the project, and is completing the post-project manual. Staff from CWEP who participated in the training and working with students included Pat Haff, Cynthia Clark, Lynne Mikuliak and Donna Roush. Staff from CLC who participated included Jennifer Sawyer and Jean Fleschute.

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A presentation on this software was made at the 1995 PAACE MidWinter Conference. A presentation on this project was made at the 1995 National Adult Literacy and Technology Conference. Other such presentations may follow. This report will be disseminated through the AdvancE and ERIC clearing house (addresses below).

AdvancE, Pennsylvania Department of Education, 333 Market Street Harrisburg, Pa. 17126-0333

ERIC (Education Resource Information Index), Ohio State University, National Center for Research in Vocational Education, 1960 Kenny Road, Columbus, Ohio 43210

PROCEDURES AND IMPLEMENTATION

The Community Women's Education Project (CWEP) and the Community Learning Center (CLC), two PDE-funded agencies located in the same building, 2801 Frankford Avenue, Philadelphia, PA, collaborated with Drexel University's Computing Resources Group on this project. They provide different and complementary kinds of educational services. CWEP works primarily toward providing long-range career-readiness, workforce literacy, and college preparatory programs, while the CLC provides a basic skills, ABE, GED and ESL curriculum. Both programs integrate writing into their curricula to aid in the development of reading, writing, and math skills, to encourage self-expression and personal awareness. Both agencies have for years been interested in exploring how computer technology might benefit their programs.

Drexel University placed Apple Macintosh PowerPC6100 computers with 8 Megabytes of RAM and built in CD-ROM drives in both agencies. The monitor used was Apple's AudioVision monitor, which has built-in speakers and microphone. Pre-installed on each machine were ClarisWorks, an integrated word processing, database, and spreadsheet program; a "Macintosh Basics" program; and a variety of other software. Speech synthesis and speech recognition software were installed on each machine in the second week. In both settings the capability to use the printer to get multiple printed copies for editing is an advantage of using these technologies.

The speech synthesizing software was field-tested by twenty students at Community Women's Education Program and twenty-seven at the Community Learning Center who attended classes held at these agencies between January 6 and June 30, 1995. The speech recognition software proved impractical to evaluate for this project (see the following section).

It was important to decide who would use the computers at each agency, where the computers would be physically placed, and how exactly would they be used in their program. Discussion revealed that each agency had a different relationship with computers, and that and other internal decisions affected how the computers from this project would be used.

CWEP uses mostly PC-compatible DOS computer systems extensively throughout their agency. The Macintosh was placed in a separate room, as it was felt

that it would be best kept separate from the other computers because of the sound components. For **Giving Voice**, there were two classes that used it.

One group of 6 learners was part of an evening class focusing on improving writing and reading skills while learning to use computers. The teacher of this class was familiar with the Macintosh interface but not the speech components of the latest models. They would work on the story by hand and edit it via written feedback from the teacher. Then they would go to the Macintosh and (with the aid of the teacher) type in their text, listen to the computer read it aloud, edit it until it was in its final form, and have the entire class listen to it.

The second group at CWEP was from a daytime literacy program called Workstart that was unable to fit this project within their regular schedule. Fourteen learners returned after classes for additional work on writing, and that is when they used the Macintosh with the speech software. In both of the CWEP classes the attendees were familiar with computers and generally expressed an interest in using the Macintosh. In both classes CWEP students were given as much time as they needed to type their already-written stories into the computer.

At CLC, their computing resources are more limited. There has only been one 386 PC machine that is occasionally available to students but is more utilized for administrative purposes. Emphasizing accessibility, CLC chose to keep the Macintosh in the main classroom. Two classes made use of it. The teachers made it available to students in both classes who expressed an interest in participating. Fourteen in one class and thirteen in another chose to spend some time as part of the project.

CLC learners had the option to use the computer whenever they had time in their class to write, based on the amount of work they had completed. This time was able to be flexible. Students both composed at the computer and typed in previously-written pieces. "At a single sitting, student use of the computer ranged from 15 minutes to an hour and a half, although most used the Macintosh for 20 minutes at a time." Users signed a log indicating the time they used the computer.

TEACHER TRAINING

It was essential to promote the active support, understanding, and involvement of the classroom teachers and administrators of the Community Learning Center

and the Community Women's Education Program, since fitting in the use of the Macintosh as well as their regular curriculum was required a significant investment of planning and training time. So a series of trainings and discussion sessions was instituted, designed to encourage them to learn how to use the Macintosh and how to integrate it and the speech software into their programs to help meet students' needs.

The first meeting with the Project Administrator and Coordinator took place at the CWEP building on Nov. 10, 1994. The ideas behind the project were explained, along with a technical explanation of speech synthesis and recognition. At the meeting, representatives from each agency were asked to think about how the computers could be integrated into their program, both physically and educationally. Mutual responsibilities were explored. The amount of training and support available to participants in the project from Drexel University was described. A revised timetable for the project was presented. It was agreed that the computers would be installed early in December and that teachers would receive some training so that they could practice over the Winter holidays if possible.

The computers were put in place for the second meeting that was held on Dec. 2. Again the training was presented to both groups. Attendees were shown the actual installation process, including how to set the connections up on the back of the computer. Most had some experience with using a PC computer, but needed an explanation of how to use the Macintosh. They received an Introduction to the Macintosh 6100CD, including using the mouse and how to open and quit programs. They received a brief introduction to the word processing software that would be available. A discussion was held about the use of process writing in each of their programs. There was a demonstration of how to give the computer commands by speech and have it obey. A schedule for future trainings was set up.

The original intent of the project in carrying on research in two sites simultaneously was that training funds could be maximized by providing training to representatives from both agencies at the same time. Unfortunately, after the second joint training, the teachers from the two agencies, including some part-time teachers, had scheduling conflicts and it was impossible to carry out further joint trainings. One group of teachers taught on Monday, Wednesday, and Friday, and the other group on Tuesday and Thursday. This necessitated more trips out to the building. It also meant that there was no particular benefit in having the entire

group at Drexel as originally planned, so each group only came to the computer lab once.

The third training was a further exploration of the Macintosh desktop, menus, and windows. More in-depth training on the word processing software was given, including the three speech synthesizing programs and ClarisWorks, an integrated word processing, database, and spreadsheet program that Drexel installed on the machines. Creating, opening, saving, and editing files, and good file storage techniques were explained and practiced. Each of the three speech synthesizing word processor programs has certain advantages and disadvantages, and their differences were highlighted and discussed so that each teacher could decide which of them to use.

In addition, the security and ethical considerations around using learners' writings for this project were explored. Each agency talked about the types of protocols it needed to develop to help gather data that they were interested in, including deciding the forms they needed to develop to document the program. CLC developed two forms, including a protocol for process writing and an evaluation to give to students. (See sample forms in Appendix.)

In the fourth training, advanced word processing techniques were taught. Teachers listened to the tones of the different "voices" in the software. Questions and answers from the teachers were resolved, both about how to use the hardware and software, and about how the program was going. Use of the graphics programs and CD-ROM disks was demonstrated, specifically using Grolier's Multimedia Encyclopedia and several other examples of CD-ROM reference software.

The fifth training included more advanced training on word processing and graphics, including importing graphics into word processing documents, as well as continued discussion of storage and hard drive use. A review of how each agency was doing with the project up to this point, and refinements were made to CLC's evaluation form.

The sixth training was used as a debriefing time, to discuss the data gathered from the project and share. Future directions for using hardware and software in the agencies were discussed. More CD-ROM software was demonstrated. Use of ClarisWorks and Nisus for desktop publishing was presented.

A Serious Difficulty with Full Project Implementation

Giving Voice to Student Writing was designed to research two technologies for their use in adult education classes, speech synthesis and speech recognition. Unfortunately, technical and time constraints prevented consideration of the many interesting possibilities of the latter technology.

At the time the grant was funded, arrangements were being worked out with Assistive Technologies, the local vendor for Articulate System's PowerSecretary to provide use of the program. The version of PowerSecretary available to this project cost $2,499. After some negotiation, they agreed to provide a copy of the latest version, ready in November, 1994, to Drexel for $1,000.

Speech recognition programs are extremely complicated and so use a great deal of RAM. RAM stands for Random Access Memory. This is short-term memory the computer uses to carry out programming. The more complicated the commands used in programming -- that is, the more you are asking the computer to do at one time -- the more RAM you need. One of the exciting and attractive aspects of PowerSecretary for this project was the claim that it worked at 45 words per minute only using 12 megabytes (MB) of RAM. The computers selected for the project came with 8 MB of RAM, and Drexel added four to each.

After experimenting with the system, in consultation with representatives of Assistive Technologies, it was determined that PowerSecretary actually takes 20 megabytes of RAM to run at all, and 24 MB to run at an acceptable speed. Without sufficient RAM the computer would simply freeze up and need to be restarted. Since at the time of the project each MB of RAM cost approximately $50, this would have entailed an additional cost of $1600 to adequately prepare the machines, which could not have been borne by this project.

Even if this RAM problem had been resolved, there were other problems with PowerSecretary which would have been problematic in its use.

PowerSecretary is advanced compared to earlier speech recognition systems. But because of the variability of pronunciation and tone of human speech, it needs to be trained to recognize the way a specific voice says words. The initial training is claimed to take about 45 minutes, but actually took closer to 1.5 hours even for a skilled and confident computer user.

For the training, the user says a list of words into the computers' microphone. The computer, in turn, creates a pronunciation "profile" of the user. Many of the words are not words likely to be familiar to ABE students. Because of this, and the necessity to have someone familiar with a computer available to operate the machine, students would need a teacher to help them through the entire training procedure. But it would also be necessary to ensure that the teacher's voice wasn't the one added to the "profile," which would lead to confused recognition.

After the initial training, PowerSecretary still needs to "hear" many words said and added to the "profile" before its artificial intelligence engine can learn to accurately predict your pronunciation and supply the correct words. It may take several weeks of practice to bring PowerSecretary to the level where it is 85% - 90% accurate.

It's quite an amazing technology, really. For an office worker, or a disabled person who can't type, or someone who's hands are not free as they work who needs to keep a record of what they're doing such as a dentist or mechanic, it might really have tremendous utility now. **In the world of adult education, in the classroom settings of CLC and CWEP, the situation makes it difficult for teachers or students to invest their energy this way. This would have taken 40 - 80 hours of time out of classes designed to fulfill students' explicit needs, and as interesting and novel as the technology may have been, learners may not have seen it helping so directly to fulfill those needs, and teachers may have been unwilling to dedicate such a high percentage of their time to meeting the needs of only one or two students.**

To work, PowerSecretary needs to be able to distinguish the voice of its user from ambient sound. This would have created problems in its use (had it even been able to run on the Macintosh 6100s) at CLC and CWEP, although the nature of their problems were opposite. CLC kept their computer in the classroom. This way the teacher was available to help with computer problems without leaving the rest of the class. The general classroom noise would have rendered PowerSecretary unusable. CWEP kept its computer in a separate room. But there, the teacher had to depart the classroom whenever the Giving Voice student needed help. Neither way is ideal.

Another difficulty was that students could only create documents in PowerSecretary's own very limited word processing program, rather than one of the full-fledged commonly available word processing programs used in this project. So a

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user would need to create her writing in PowerSecretary and then export to another program to edit or change the appearance of their document.

In hard science, no experiment is a considered a *failure*. Whether or not the intended result comes about, the experimenters have learned *something*. By spending many hours examining the current implementation of speech recognition, by demonstrating it and receiving feedback from ABE professionals at PAACE MidWinter, ALT, and on other occasions, we learned much about the potential and the limitations of the state of the art. We also learned that as of 1994-95 the classrooms of the two agencies involved in this grant were not appropriate settings for its use.

In the near future speech recognition clearly has some application for students who have trouble writing and reading. The price is going down (by July 1995 the list price of the version of PowerSecretary used in this project was down to $1,000), the usefulness is expanding (it now works with WordPerfect and MacWrite), and the quality of recognition is going up (at least this is claimed for the new $2,500 version).

USING THE TEACHER'S MANUAL

Giving Voice to Student Writing: Activities for Word Processing with Speech Synthesis was designed to provide a curriculum guide for using speech synthesis in an adult education curriculum. It was developed after the completion of the project based on the experiences of the teachers and students. Users should modify the lessons to meet the needs and demands of the particular class they are used in. This sequence of lessons provides a good basis for implementing a speech synthesis project in any process writing class which has the technology available.

GIVING VOICE TO STUDENT WRITING:

ACTIVITIES FOR WORD PROCESSING WITH SPEECH SYNTHESIS

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APPENDIX I: SPEECH SYNTHESIS SOFTWARE FOR APPLE MACINTOSH AND DOS/WINDOWS/WINDOWS95 COMPUTERS

SPEECH SYNTHESIS SOFTWARE
MACINTOSH SPEECH SYNTHESIS SOFTWARE
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AN OVERVIEW OF PEER EDITING
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APPENDIX III: INTRODUCTION TO THE MACINTOSH TIPSHEETS

EVALUATION

According to the criteria in the proposal, the success of this project was to be judged according to the following criteria:

1. **the number of students who utilize the computers through the course of the project;**

The grant specified that, "At least 15 students from each agency will have stories read to them by the computer." Twenty students at CWEP and twenty-seven at the CLC used the computers.

2. **the quality of the experience for the learners and teachers, to be determined by interviews and questionnaires;**

The experience reported by teachers and learners was generally quite positive. As with any group of learners and any given technology, be it the lecture format, a chalk board, or a workbook, some learners found it more valuable and appealing than others. All of the teachers expressed an interest in continuing to explore the use of the technologies.

The teachers each wrote reports describing the results of the speech synthesis program on student writings. The learners from CLC completed questionnaires. The remainder of this report is based on their written evaluations and verbal discussions.

3. **an analysis of the writings, examining their length, sentence length and complexity, and the amount of editing done on each;**

Length of compositions did not change. It was not possible to do a careful evaluation of all the factors inherent in this. Students had the same amount of time to compose as when they wrote by hand, but they were slower typers. On the other hand it may have been easier to correct their mistakes on the computer. A further study designed to look more carefully at these factors would be helpful.

Average length of sentences did not appear to change over the course of the study because students did not generate enough text to adequately evaluate this, but the length of many specific sentences did. The technology led students to change sentence length in two ways. On hearing their compositions read, students detected more run-on sentences because the computer kept droning on, even after they could

sense it should have paused. They then turned these run-on sentences into smaller well-formed sentences. Second, students detected more sentence fragments that they re-wrote into full sentences. The report from CWEP says:

> The computer is the best at pointing out run-on sentences. None of the students missed hearing them if they existed in their compositions.

In using the technology for general editing, the report from CLC says:

> First they would type out a piece of their own work... Then we would print out one copy... After that, they would put on the earphones and listen to their work. At first they would laugh and think it was rather cute, but then they started to hear all the mistakes.... They would then go back and ask themselves if they liked it and/or wanted to make changes. After the second copy was printed one of the instructors ... would listen to it with them...

From CWEP:

> It was also good at illustrating an over-use of commas as the pauses seemed even more unnecessary in the "computer voice." For one student I had to re-play a phrase 6 times alternating the comma in with the comma removed before she heard that it wasn't needed. The re-play feature, often for only a phrase, was an excellent function of the computer. It often took the place of the questioning I did during manual editing.
>
> (Speech synthesis) helped train their "ear" to listen for punctuation and correct spelling. People seemed to easily recognize when they had omitted punctuation when the computerized voice didn't ... pause. In their regular writing, it seemed much more difficult for them to realize where the punctuation should appear... The computer was also good when a word was horribly misspelled... It would pronounce the word wrong in a way that the student could clearly hear. This worked well for "nowing" for "knowing."
>
> In manual editing students are more likely to see what they THOUGHT they wrote, or what they meant to write. When a student wrote "away" when she meant "always," I had to ask her to reread the phrase a number of times before she caught it. Manual editing is much less likely to catch run-on sentences or sentence fragments.

4. **the results of interviews with teachers, tutors, and students who interact with the courseware.**

The report from the CWEP said:

> Overall the Macintosh proved to be an excellent teaching tool as a support of the writing process... It is especially helpful for aural learners who don't always see errors in their work. It would be great to have several (with earphones) in all of our classrooms...

And the Community Learning Center reported that this project

> ...greatly increased our students' opportunity to use a computer. When asked, most participants felt that they had adequate time at the computer and most reported that they enjoyed the experience. The majority... described their experience with enthusiasm: "It was great because learning the computer is fun," and, "It's great. You get to use something different," were some of the comments. When asked to describe what it was like to hear their pieces read by the computer, students' reactions ranged from tentative to enthusiastic. Most reported that they changed their writing after the computer read it to them.
>
> ...some students said that they added more text to their writing. Most participants surveyed said that hearing their work did *not* allow them to recognize their mistakes, which is interesting because even these students indicated that they made changes based on what they heard. Perhaps they were reacting to the difficulty of understanding the computer voice: "I can't really understand it," was a common reaction. Although most of the students surveyed indicated that they would like to work more on the computer, only about half wanted to continue using the voice synthesis, Given the choices presented in the Computer Feedback Log (see Appendix), most participants rated another person over the computer or working alone as the preferred method of working on their writing.
>
> The changes they made were usually mechanical such as correcting their spelling, adding quotation marks, or adding a missing word. Also, some students said that they added more text to their writing.

KEY CONSIDERATIONS AND RECOMMENDATIONS BASED ON PROJECT RESULTS

1. Location of the computer and access to headphones and the teacher were important. It was "difficult for more than one (person) at a time" (CWEP) to use the computer because, although writing and editing can be group processes, imputting text is not. If there were **more computers** available, people could sit next to each other and make comments about the work.

2. According to CWEP, "(Speech synthesis could be) useful for people editing longer pieces, " but it was used only for short pieces in this project.

3. "The better writing students caught errors more quickly both manually and on the computer..." (CWEP)

4. "If there was a problem with homonyms the student still didn't catch it as the computer said it the same. I used the "repeat" function when I wanted a student to hear the difference between 'witch' and 'which.' Some words were so close that I would substitute the correct spelling and ask the student to listen to both versions and choose the one they wanted. This worked very well as the students were making the choice." (CWEP)

5. "The computer was not as good at pointing out verb tense problems. This wasn't surprising as some of the students don't have a good "ear" for tense mistakes. They take spoken errors with them into their writing, it is one of the hardest things to un-learn. The computer had no way of illustrating the random capitals that some students favor." (CWEP) Possibly attaching the speech synthesis to a grammar-checker would be useful, although checkers are not yet very user-friendly for people without high-level reading skills.

6. Students had varying reactions to the computer voices. CLC students said, "(It) sound(s) weird," "different," "it felt funny to hear the computer talk," "It was okay, but it could have been more clear," "It was wonderful to hear something that came out of a computer." It was useful to have a variety of voices so that they could pick one with which they were comfortable.

7. At CLC, "Most participants surveyed said that hearing their work did *not* allow them to recognize their mistakes, which is interesting because even these students indicated that they made changes based on what they heard. Perhaps

they were reacting to the difficulty of understanding the computer voice: "I can't really understand it," was a common reaction.

8. Although most of the students surveyed indicated that they would like to work more on the computer, only about half reported that they wanted to continue using the voice synthesis software. Further questioning might reveal more about why they felt this.

   Several students who felt that they were teased by others about their writing in class because of their abilities indicated that they found the speech synthesis particularly valuable and would like to continue using it. The teachers speculated that this is because it allowed them to hear their words verbalized but without such a critical audience.

9. Starting the project at the beginning of the school year, thus allowing students to have more experience with the software over a longer period of time, would have allowed for a more accurate gauge of student reaction to the software.

10. An interesting study would be to compare how student so varying literacy levels react to the voice synthesis and improve their writing using voice synthesis.

11. An earlier start-up date and more time to explore various ways to deeply integrate computers into classrooms would have been better.

12. More time should be allowed to provide more opportunity for a more careful scientific study to compare writing improvement using voice synthesis with process writing without the computer voice.

CONCLUSION

This program met all of its original goals of curriculum planning, implementation and student recruitment. However, the planning underestimated the amount of time and effort needed to effectively integrate this technology.

At the time of this project, speech synthesis can be considered a real and available option in the average computer-using ABLE classroom. Speech recognition cannot.

Overall reactions indicated that using inexpensive speech synthesis in a process writing curriculum was considered interesting and valuable by both students and staff. More computers, more training, and more time to explore a wider variety of integration options would likely have yielded greater results.

On a larger scale, readily available speech synthesis and recognition may have an enormous effect on what we think of as reading and writing in today's society. Oral speech is very different from written speech, and these technologies may lead to a convergence of these two communication styles. What if we no longer need the visual skill of reading because we can hear the computer speak the words? What if we no longer need the physical skills of writing and typing because we just dictate to the computer, then ask it to run the spell and grammar-checkers, making needed corrections and automatically using the thesaurus when it encounters repeat words? We should think about what effects this technology will have on long-range jobs options, for instance, when we train people to enter data or word process.

APPENDIX

Protocol for Process Writing from Community Learning Center

Computer Feedback Log

Protocol for Process Writing

1) Type original work. (It has to be **your own work**.)
2) Print out and label as 1st draft.
3) Listen to computer read your writing.
4) Ask yourself if you would like to or need to make changes.
5) Make those changes.
6) Print out and label as 2nd draft.
7) Listen again with Jean or Jennifer and discuss
8) Ask yourself if you would like to make any final changes.
9) Make final changes.
10) Print out and label 3rd draft.

Name _____ Date _____

Community Learning Center

COMPUTER USE LOG

1) How long did you work on the computer today? _____

2) Did you feel you had enough time to work at the computer? Explain

3) What did you think of working on the computer?

4) What did you think of hearing your piece read by the computer?

5) Did you change your story after the computer read it to you? Ó Yes Ó No
If yes, what kinds of changes did you make?

6) Did hearing your piece allow you to recognize mistakes? Ó Yes Ó No
If yes, please explain.

7) Would you like to use the computer more? Why or why not?

8) Would you like to use the computer voice more? Why or why not?

10) How do you prefer to work on your stories? Rate 1 (favorite) --> 5 (least favorite)
__ Computer
__ Teacher
__ Alone without assistance or help from the computer or teacher
__ With friend or classmate

__ OTHER (EXPLAIN)